GENERAL SCIENCE
10-20-30

PROGRAM OUTLINE

DRAFT: 87 09 24

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GENERAL SCIENCE
10-20-30

PROGRAM OUTLINE

DRAFT: 87 09 24

GOALS AND OBJECTIVES

1.00 Acquire a Foundation of Knowledge in the Natural Sciences.

1.10 know some of the fundamental ideas of Science:

1.11 understanding the structure and composition of matter, and the interaction among its components

1.12 understand the conservation of matter and energy in reaction systems

1.13 understand the interdependence of living organisms with one another and with their environment

1.14 understand and value the uniqueness, diversity and changing nature of life forms

1.15 understand the physical laws and theories that govern the universe

1.16 understand that chemical and physical systems are dynamic equilibrium systems

1.17 understand that humans are unique in their responsibility for the impact on universal systems.

1.20 view the knowledge as part of a systematic explanation for natural phenomena;

1.30 use the knowledge learned when interpreting natural phenomena.

2.00 Comprehend the Nature of Science.

2.10 understand that science is a disciplined way to develop explanations for the events and objects of the natural world:

2.11 understand that observable data plays an important role in the development of scientific knowledge

2.12 understand that scientific explanations are developed through interpretations and conceptual inventions which are theoretical in nature

2.13 recognize that proposed theories may be supported or refuted by experimental results.

2.20 develop skill in the processes of science: questioning, proposing data, designing experiments, observing and measuring, processing data, and interpreting data.

2.30 recognize that scientific knowledge is cumulative and subject to change.

3.00 Understand the Relationship between Technology and Science.

3.10 understand the nature of technology as a process of solving practical problems;

3.20 understand that the scope of technological development includes both techniques and products:

3.30 use scientific knowledge to explain and understand technological devises;

3.40 know that science can be used to advance technology and that technology can be used to advance science;

3.50 be familiar with existing and emerging technology

4.00 Understand the Role of Science and Technology in Societal Issues.

4.10 understand that science and technology influence and are influenced by societal issues:

4.20 understand that many of the effects of science and technology on society are unforseen;

4.30 become aware of the interaction of societal factors such as financial. political. ethical. and moral forces with science and technology;

4.40 appreciate the societal impact of the interdependence of technological processes, techniques and products:

4.50 be aware of the need for trade-offs in order to arrive at workable situations involving science and technology in society;

4.60 evaluate the appropriateness of various societal decisions in terms of related scientific and technological thinking.

SCOPE AND SEQUENCE

TOPIC I: What is an Energy System?

20 hours

OVERVIEW

The focus of the unit is on the organization of empirical data through mathematical, communication and process skill development.

Drawing on the students personal energy consumption, the concept of energy systems is organized into inputs, conversions and outputs.

From analyzing their personal energy consumption, the concepts of food-web systems, measuring energy, and converting energy are developed.

The concepts of energy systems are broadened to include some of the societal aspects of use and abuse of energy, and the concepts of renewable and non-renewable energy sources.

SUGGESTED SUBJECT MATTER

1. Energy Systems: Heat, Radiant, Mechanical, Chemical, Electrical, and Nuclear
2. Calorimetry
3. Systems Diagrams: Input, Conversion and Output
4. Renewable and Non-renewable Energy Resources (Introduction only)
5. Energy Conversion
6. Environmental Impact of Energy Use
7. Work, Energy and Power
8. Food Webs and Photosynthesis Respiration

TOPIC II: Formation of Scientific Models

20 hours

OVERVIEW

The focus of this unit is on the manipulation and analysis of data and development of models.

Using the earth as a model the unit focuses on the gathering of data that can be utilized to explain the existence of such forces as hurricanes, tornadoes, glaciers, volcanoes and earthquakes.

The analysis of this data is used to explain current theories of the earth's structure, plate-tectonics and weather patterns.

Applications of these theories are used to gather further data that can be used to modify, expand or explain the model of the earth as it was initially presented.

SUGGESTED SUBJECT MATTER

1. Formation of the Earth
2. The Earth's Structure
3. Plate Tectonics
4. Mountain Building (earthquakes volcanoes)
5. Erosion (glaciers, rivers, wind)
6. Oceans
7. Atmosphere
8. Violent Weather
9. Weather Forecasting
10. Technology
    - Satellite photos
    - Seismology

TOPIC III: Water Resources

20 hours

OVERVIEW

The focus of this unit is on the nature of water and its uses, and on responsible decision-making on water management.

The students are to become aware of the issues concerned with water distribution, purity and ownership.

Starting with a presentation of biological importance, where water is found, and the technologies of how it is distributed and purified, students will examine the physical and chemical properties of water as they are related to the specific technologies.

SUGGESTED SUBJECT MATTER

1. Water Cycles
2. Cloud Seeding
3. Dissolved Oxygen and Water Pollutants (Introduction)
4. Water Treatment
5. Ion Exchangers
6. Chemical and Physical Properties of water
7. Current Legislative Policy

SCOPE AND SEQUENCE

TOPIC IV: Immunology, the Wars Within

20 hours

OVERVIEW

The focus of the unit is on biological science and biotechnology in order to provide an introduction to biotechnology and biomedical processes.

The students are to gain an understanding of the science and technology that have responded to the health issues being discussed.

Basic biological concepts will be covered as they relate to the health issues that are being investigated.

The students will be examining various factors and the appropriateness of health decisions as they relate to the biotechnical applications and processes understudy.

SUGGESTED SUBJECT MATTER

1. Cell Theory
2. Rejection
3. Recombinant DNA
4. Genetic Engineering
5. Antibiotics
6. Immunology
7. Inoculation Immunization
8. Medical Technology

TOPIC V: Product Evaluation by Design

20 hours

OVERVIEW

The focus of this unit is on developing skill in the process of science through the design of an experiment to evaluate the specific merits of a product of their choice.

The specific design will take into account available resources and expertise and selection of appropriate control variables and hypothesis. The design will necessitate the student to become familiar with the particular concepts that are pertinent to the consumer product that is chosen.

The actual design may duplicate an existing design in order to support existing data; examine the specific claims made in terms of a given product: or examine the physical or chemical properties of a product in order to arrive at an evaluation of that product.

SUGGESTED SUBJECT MATTER

1. Scientific process skills.
2. Concepts related to specific product chosen
3. Generic and Brand Name
4. Consumerism

TOPIC I: WHAT IS AN ENERGY SYSTEM?

OVERVIEW:

The focus of the unit is on the organization of empirical data through mathematical, communication and process skill development.

Drawing on the students personal energy consumption, the concept of energy systems is organized into inputs, conversions and outputs.

From analyzing their personal energy consumption, the concepts of food-web systems, measuring energy, and converting energy are developed.

The concepts of energy systems are broadened to include some of the societal aspects of use and abuse of energy, and the concepts of renewable and non-renewable energy sources.

OBJECTIVES:

CONCEPTS:

1. Energy systems can be organized into input, conversion and output.
2. Energy can be measured in quantitative terms.
3. Total energy of a system is conserved.
4. Useful energy can be lost.
5. Efficiency of an energy system can be calculated.
6. Personal energy consumption can be determined.
7. There are renewable and non-renewable energy sources.

SKILLS:

1. Selection of appropriate scientific skills.
2. Recording and Interpretation of data.
3. Preparation of systems diagrams.
4. Calculation of energy consumption or production using calorimetry.
5. Graphical analyzes of empirical data.
6. Extrapolation and interpretation of graphs.
7. Development and employment of skills for accessing and processing information in a technologically advanced environment.
8. Recognize components and interaction within systems.
9. Recognize the limits of science and technology in problem solving.
10. Demonstrate the ability to design a simple experiment.
11. Use precise symbols and terminology of science and mathematics in oral and written communication.
12. Develop psychomotor manipulative skills.

ATTITUDES:

1. Develop a positive attitude towards mathematical communication and scientific processes and skills.
2. Appreciate the usefulness of computational competence.
3. Be concerned and active regarding preservation and use of resources.
4. Develop responsible attitudes toward consumption as it is relates to personal and global needs.
6. Be open to new ideas, insights and change.
7. Strive to develop a philosophy of life that reflects responsibility to self as well as to others in a highly complex and changing world.

TOPIC I: WHAT IS AN ENERGY SYSTEM? (cont'd)

SUGGESTED SUBJECT MATTER:

1. Energy Systems: Heat, Radiant, Mechanical, Chemical, Electrical, and Nuclear
2. Calorimetry
3. Systems Diagrams: Input, Conversion and Output
4. Renewable and Non-renewable Energy Resources (introduction only)
5. Energy Conversion
6 Environmental Impact of Energy Use
7. Work, Energy and Power
8. Food Webs and Photosynthesis Respiration

TOPIC II: FORMATION OF SCIENTIFIC MODELS

OVERVIEW:

The focus of this unit is on the manipulation and analysis of data and development of models.

Using the earth as a model the unit focuses on the gathering of data that can be utilized to explain the existence of such forces as hurricanes, tornadoes, glaciers, volcanoes and earthquakes.

The analysis of this data is used to explain current theories of the earth's structure, plate-tectonics and weather patterns.

Applications of these theories are used to gather further data that can be used to modify, expand or explain the model of the earth as it was initially presented.

OBJECTIVES:

CONCEPTS:

1. Science has helped to formulate models, such as that of the earth.
2. Science has postulated theories to explain major forces of nature.
3. Theories can be used to support or refute models.
4. Models are reformulated on the basis of new evidence.

SKILLS:

1. Develop powers of observation.
2. Develop skills in interpretation of data.
3. Develop the ability to look for patterns in nature.
4. Utilize established scientific models as a comparative base for observed data.
5. Recognize the limits of science and technology in problem solving.
6. Recognize components and interactions within systems.

ATTITUDES:

1. Appreciate that proposed theories may be supported or refuted by experimental results.
2. Recognize that scientific knowledge is cumulative and subject to change.
3. Appreciate the relationship between science and technology.
4. Appreciate the beauty and grandeur of the natural environment.

TOPIC II: FORMATION OF SCIENTIFIC MODELS (cont'd)

SUGGESTED SUBJECT MATTER:

1. Formation of the Earth
2. The Earth's Structure
3. Plate Tectonics
4. Mountain Building (earthquakes, volcanoes)
5. Erosion (glaciers, rivers, wind)
6. Oceans
7. Atmosphere
8. Violent Weather
9. Weather Forecasting
10. Technology
    - Satellite photos
    - Seismology

TOPIC III: WATER RESOURCES

OVERVIEW:

The focus of this unit is on the nature of water and its uses, and on responsible decision-making on water management.

The students are to become aware of the issues concerned with water distribution, purity and ownership.

Starting with a presentation of biological importance, where water is found, and the technologies of how it is distributed and purified, students will examine the physical and chemical properties of water as they are related to the specific technologies.

OBJECTIVES:

CONCEPTS:

1. All life depends upon the purity and availability of water.
2. Water changes to various physical states within the hydrologic cycle.
3. Technology can assist in the distribution and purification of water.
4. Science can account for many of the chemical and physical properties of water.
5. Many societal factors are involved in water management.

SKILLS:

1. Recognize the need to balance long term environmental objectives with economic and social needs.
2. Provide examples of the ecological interactions and interdependency among people and the environment.
3. Examine the effects of human behaviour on the environment.
4. Demonstrate awareness of global issues and the contribution of local activity to the resolution of global problems.
5. Understand and apply data collection, organization, and interpretation skills.
6. Utilize and evaluate various approaches for assessing and solving problems.
7. Examine and assess a variety of viewpoints on controversial issues before forming an opinion.
8. Develop and employ skills for accessing and processing information in a technologically advanced environment.

ATTITUDES:

1. Understand that science and technology influence and are influenced by societal issues.
2. Become aware of the interaction of societal factors such as financial, political, ethical, and moral forces with science and technology.
3. Be aware of the need for trade-offs in order to arrive at workable situations involving science and technology in society.
4. Possess an attitude of being in harmony with the environment.

TOPIC III: WATER RESOURCES (cont'd)

SUGGESTED SUBJECT MATTER:

1. Water Cycles
2. Cloud Seeding
3. Dissolved Oxygen and Water Pollutants (Introduction)
4. Water Treatment
5. Ion Exchangers
6. Chemical and Physical Properties of water
7. Current Legislative Policy

TOPIC IV: IMMUNOLOGY, THE WARS WITHIN

OVERVIEW:

The focus of the unit is on biological science and biotechnology in order to provide an introduction to biotechnology and biomedical processes.

The students are to gain an understanding of the science and technology that have responded to the health issues being discussed.

Basic biological concepts will be covered as they relate to the health issues that are being investigated.

The students will be examining various factors and the appropriateness of health decisions as they relate to the biotechnical applications and processes understudy.

OBJECTIVES:

CONCEPTS:

1. Biotechnology includes genetic engineering, bioprocessing, and antibody production.
2. Immunology is a natural process within our bodies.
3. Biotechnical and biomedical processes have greatly enhanced our immune system.
4. Immunization technology is used on scientific biological principles.
5. Many of the factors behind biotechnical and biomedical processes have societal impacts.
6. Research in biotechnical and biomedical areas must resolve many societal issues.

SKILLS:

1. Analyze critically the possible impact of scientific research and technological development disease control.
2. Recognize the limits of science, and technology in problem solving.
3. Differentiate and analyze factors that are involved in developing technological processes.

ATTITUDES:

1. Appreciate the ethical dilemmas that may arise from the application of scientific and technological developments.
2. Appreciate the variety of factors that relate to a given technological process.
3. Appreciate the relationship between science and technology.

TOPIC IV: IMMUNOLOGY. THE WARS WITHIN (cont'd)

SUGGESTED SUBJECT MATTER:

1. Cell Theory
2. Rejection
3. Recombinant DNA
4. Genetic Engineering
5. Antibiotics
6. Immunology
7. Inoculation/Immunization
8. Medical Technology

TOPIC V: PRODUCT EVALUATION BY DESIGN

OVERVIEW:

The focus of this unit is on developing skill in the process of science through the design of an experiment to evaluate the specific merits of a product of their choice.

The specific design will take into account available resources and expertise and selection of appropriate control variables and hypothesis. The design will necessitate the student to become familiar with the particular concepts that are pertinent to the consumer product that is chosen.

The actual design may duplicate an existing design in order to support existing data; examine the specific claims made in terms of a given product; or examine the physical or chemical properties of a product in order to arrive at an evaluation of that product.

OBJECTIVES:

CONCEPTS:

1. Products have many characteristics that can be scientifically investigated.
2. Experimental design involve several scientific process skill components.
3. Data is more meaningful when organized.
4. Communication is an important step in the interpretation of experimental results.
5. The results of an experiment can be used to evaluate the design of the experiment.

SKILLS:

1. Appreciate that observable data play an important role in the development of scientific knowledge.
2. Develop skill in the processes of scientific experimental design.
3. Recognize that scientific knowledge is cumulative and subject to change.
4. Be familiar with existing and emerging technology.
5. Construct meaningful communications and analyze the communications of others.
6. Develop and employ skills for accessing and processing information in a technologically advanced environment.
7. Understand the relationship between expectations of consumers and responsibilities of producers.

ATTITUDES:

1. Appreicate that science is a disciplined way to develop explanations for the events and objects of the natural and technological world.
2. Display an interest in consumer needs and consumer protection laws.
3. Appreciate the effects of advertising and the mass media on consumerism.
4. Have developed a positive attitude towards mathematical and scientific processes and skills.
5. Appreciate the usefulness of problem solving skills.

TOPIC V: PRODUCT EVALUATION BY DESIGN (cont'd)

SUGGESTED SUBJECT MATTER:

1. Scientific process skills.
2. Concepts related to specific product chosen
3. Generic and Brand Name
4. Consumerism

SCOPE AND SEQUENCE
Electives

TOPIC: HOUSE POWER (Relates to Energy Unit) 5 hours

OVERVIEW

Students will use the knowledge acquired in the energy unit to explore the electrical system of their own homes, or of the school. Emphasis in on technology.

ACTIVITY

Students will map the electrical system of their home. Use simple mathematics to determine current of each circuit.

Study devises used in home: toaster, irons, radios, etc.

Compare the loads of several devises.

Discuss the problems of overload. Perhaps and experiment could be done to show effects of overloading.

TOPIC: TEMPERATURE REGULATION (Relates to Energy Unit) 5 hours

OVERVIEW

Students will explore devices which provide heat to the house/school, and the technology of regulating the heat.

ACTIVITY

Study the workings of a house furnace. Calculate heat generated by the burning of fixed amounts of fuel.

Compare furnace types, including new technologies. Obtain literature from heating companies and evaluate the literature.

Study the workings of the water heater.

Take apart a thermostat, to understand the way it works.

Experiment with forms of household insulation, or evaluate household insulation by comparing types of insulation.

TOPIC: TEMPERATURE CONSERVATION IN THE HOUSE/SCHOOL (Relates to Energy Unit) 5 hours

OVERVIEW

Students will evaluate the current wastes of energy in a building and propose ways of improving efficiency.

ACTIVITY

View the building from the outside, inspect places that heat is lost. Do in the cold weather.

If possible, obtain an infra-red heading of the same building, and compare results

Propose methods of preventing heat loss.

Propose other methods of preventing general energy waste.

SCOPE AND SEQUENCE
ELECTIVES

TOPIC: LOCAL WEATHER (Relates to Powers of Nature)

5 hours

OVERVIEW

Students will design and use a set of apparatus to map local weather over a period of time.

ACTIVITY

Students will build a simple barometer, anemometer, thermometer.

Students will simultaneously gather data, over a period of time which could be spaced throughout the year.

Compare data gather by each, to compare how effective their devises were.

TOPIC: WORLD CLIMATE (Relates to Powers of Nature)

5 hours

OVERVIEW

Students will study a system of world climate.

ACTIVITY

Students determine major factors of climate.
Study Koeppen system of classification.
Apply classification to various geographical locations.
Discuss limitations of such a system.

SCOPE AND SEQUENCE

TOPIC I: Earth's Finite Resources

25 hours

OVERVIEW

The focus of the unit is on the interrelations among science, technology and society.

By examining issues related to resource development, management and conservation, students are to gain an understanding of the science and technology involved in the issue being discussed. Students will consider the problems associated with the use and abuse of various Canadian resources, both renewable and non-renewable.

The students are to become aware of the issues concerned with the use of renewable and non-renewable resources.

SUGGESTED SUBJECT MATTER

1. Renewable and Non-renewable Resources
2. Canadian Forest Industry
3. Canadian Mining Industry
4. Basic Metallurgy
5. Conservation and Recycling of Resources
6. Soil Conservation
7. Game Management

TOPIC II: Renewable Energy Sources

25 hours

OVERVIEW

The focus of the unit is on scientific principles involved in energy conversion and storage, and the technologies which have been developed.

Drawing on the students experiences with various forms of energy use in society, the concept of renewable energy sources is developed.

Students will explore several renewable sources, and explore the technologies that allow us to use the energy in our homes, transportation devices, factories, offices.

The topic will also address the environmental and economic factors and will introduce the student to the General Science 30 unit on non-renewable sources of energy.

SUGGESTED SUBJECT MATTER

1. Review of content of General Science 10 energy unit (as related to concepts and skills developed in activities).
2. Definition of renewable energy source (as compared with non-renewable source).
3. Wind, solar, tide, hydro-electric, geothermal, hydrogen energy
4. Analysis on energy conversion technology and energy storage technology.
5. Economic and environmental impact of energy technologies.

TOPIC III: The Expanding Universe

25 hours

OVERVIEW

The focus will be on the nature of science, with an appreciation of the development of scientific thought.

Students will explore the historical development of man's view of the universe.

Both Newtonian and relativistic concepts will be used to solve problems involving motion in space.

New technology provides evidence that support the tentative nature of models.

SUGGESTED SUBJECT MATTER

1. Ptolmaic Model
2. Copernican Model
3. Conflicts with Authority and Dogma
4. Keplers Laws
5. Newton's Laws (Universal Gravitation)
6. Distance Measurement. example: parallax. HR diagram. copheids. Hubbel's Constant
7. Discovery of Galaxies. Expanding Universe. Big Bang

SCOPE AND SEQUENCE

TOPIC IV: Biochemical Applications

25 hours

OVERVIEW

The focus of the unit is on biochemistry and biotechnology.

It is to provide a continuation of the study of biotechnology begun in Science 10.

By examining issues related to food production and storage, and issues related to industrial applications of biotechnology, students are to gain an understanding of the science and technology of pertinent issues. Students will consider the problems associated with the use of pesticides, herbicides and food additives in the food industry and with the use of biochemistry in industry

SUGGESTED SUBJECT MATTER

1. Introductory Microbiology
2. Introductory Biochemistry
3. Food Production
4. Food Storage and Preservation
5. Biochemistry in Industry

TOPIC I: EARTH'S FINITE RESOURCES

OVERVIEW:

The focus of the unit is on the interrelations among science, technology and society.

By examining issues related to resource development, management and conservation, students are to gain an understanding of the science and technology involved in the issue being discussed. Students will consider the problems associated with the use and abuse of various Canadian resources, both renewable and non-renewable.

The students are to become aware of the issues concerned with the use of renewable and non-renewable resources.

OBJECTIVES:

CONCEPTS:

1. Resources can be classified as renewable and non-renewable.
2. Imbalances occur in global resource distribution.
3. Decisions are made regarding conservation or utilization of resources.
4. Many factors are involved in making responsible decisions.
5. Increased utilization of the earth's resources may result in scarcity and environmental damage.
6. Humanity is dependent on the responsible use of science and technology.
7. Earth's finite limits may necessitate a search for alternatives.

SKILLS:

1. Analyze critically the possible impact on society of scientific research and technological development in resource management.
2. Demonstrate ways to make efficient use of resources.
3. Differentiate and analyze factors that are involved in a successful technological processes.

ATTITUDES:

1. Be concerned and active regarding preservation and wise use of the natural environment and its resources.
2. Realize the interdependency of human beings with the environment.
3. Appreciate the ethical dilemmas that may arise from the application of scientific and technological developments.
4. Appreciate the variety of factors that relate to developing a successful technological process.
5. Appreciate the interrelationships among science, technology, and society.
6. Appreciate the limits of science and technology in solving social problems.
7. Appreciate the need to balance long term environmental objectives with economic and social needs.

TOPIC I: EARTH'S FINITE RESOURCES (cont'd)

SUGGESTED SUBJECT MATTER:

1. Renewable and Non-renewable Resources
2. Canadian Forest Industry
3. Canadian Mining Industry
4. Basic Metallurgy
5. Conservation and Recycling of Resources
6. Soil Conservation
7. Game Management

TOPIC II: RENEWABLE ENERGY SOURCES

OVERVIEW:

The focus of the unit is on scientific principles involved in energy conversion and storage, and the technologies which have been developed.

Drawing on the students experiences with various forms of energy use in society, the concept of renewable energy sources is developed.

Students will explore several renewable sources, and explore the technologies that allow us to use the energy in our homes, transportation devices, factories, offices.

The topic will also address the environmental and economic factors and will introduce the student to the General Science 30 unit on non-renewable sources of energy.

OBJECTIVES:

CONCEPTS:

1. Some energy sources can be classified as renewable sources.
2. Availability of renewable energy sources varies globally.
3. Conversion of energy to useful energy involves technology.
4. Efficiency of renewable resources has implications for conservation.
5. Energy can be collected and stored.

SKILLS:

1. Understand and apply data collection, organization, and interpretation skills.
2. Use appropriate strategies in problem solving.
3. Analyze data mathematically.
4. Use precise terminology in science in oral and written communication.
5. Recognize the components and interactions within systems.
6. Analyze critically the possible impact of scientific research and technological development on society.
7. Quantitatively demonstrate ways to make efficient use of resource.
8. Be able to build a simple energy conversion or storage device.

ATTITUDES:

1. Appreciate that in solving scientific problems new technologies and problems develop.
2. Appreciate the relationship between science, technology and society.
3. Appreciate the theoretical and manipulative skills involved in creating technology.
4. Be concerned with the wise use of the natural resources.
5. Value the development of information, science and technologies while continuing to cultivate human values and be responsive to human needs.
6. Value both cooperation and competition as they are played out in world economic systems and the resultant impact on society.
7. Appreciate the advantages of utilizing renewable energy sources.
8. To appreciate economic considerations with respect to choice of energy and technologies.

TOPIC II: RENEWABLE ENERGY RESOURCES (cont'd)

SUGGESTED SUBJECT MATTER:

1. Review of content of General Science 10 energy unit (as related to concepts and skills developed in activities).
2. Definition of renewable energy source (as compared with non-renewable source).
3. Wind, solar, tide, hydro-electric, geothermal, hydrogen energy.
4. Analysis on energy conversion technology and energy storage technology.
5. Economic and environmental impact of energy technologies.

TOPIC III: THE EXPANDING UNIVERSE

OVERVIEW:

The focus will be on the nature of science, with an appreciation of the development of scientific thought.

Students will explore the historical development of man's view of the universe.

Both Newtonian and relativistic concepts will be used to solve problems involving motion in space.

New technology provides evidence that support the tentative nature of models.

OBJECTIVES:

CONCEPTS:

1. Models of the universe have changed over time.
2. Many principles of physics are involved in the technology of astronomy.
3. New information is constantly changing our model of the universe.
4. The physical universe exhibits phenomena which can be described in terms of mathematical relationships.

SKILLS:

1. Demonstrate a knowledge and understanding of basic mathematical skills.
2. Understand and apply data collection, organization and interpretation skills.
3. Use calculators and computers to aid in the solution of problems.
4. Use appropriate strategies in problem solving.
5. Apply the principles of the scientific method to specific physical questions.
6. Utilize established scientific models as a comparative base for observed data.
7. Recognize components and interactions within systems.
8. Recognize the characteristics of scientific theory.

ATTITUDES:

1. Value the contribution of science and mathematics to our cultural heritage and to the progress of civilization.
2. Recognize that as new observations become available, sometimes through the development of new technologies, theories have to be altered or rejected.
3. Appreciate the conflict that exists when scientific theory is taken as fact or dogma.
4. Appreciate the beauty and grandeur of the night sky.
5. Realize the limits in our knowledge of the universe.

TOPIC III: THE EXPANDING UNIVERSE (cont'd)

SUGGESTED SUBJECT MATTER:

1. Ptolmaic Model
2. Copernican Model
3. Conflicts with Authority and Dogma
4. Keplers Laws
5. Newton's Laws (Universal Gravitation)
6. Distance Measurement, example: parallax, HR diagram, copheids, Hubbel's Constant
7. Discovery of Galaxies, Expanding Universe, Big Bang
8. Discovery of Galaxies. Expanding Universe. Big Bang Theory

TOPIC IV: BIOCHEMICAL APPLICATIONS

OVERVIEW:

The focus of the unit is on biochemistry and biotechnology.

It is to provide a continuation of the study of biotechnology begun in Science 10.

By examining issues related to food production and storage, and issues related to industrial applications of biotechnology, students are to gain an understanding of the science and technology of pertinent issues. Students will consider the problems associated with the use of pesticides, herbicides and food additives in the food industry and with the use of biochemistry in industry .

OBJECTIVES:

CONCEPTS:

1. Biologically related technologies such as food production, and preservation directly improve the quality of life.
2. Many Canadian scientists have contributed to the field of biotechnology.
3. Food production provides people with the nutrients needed for survival.
4. Food preservation techniques keep food from spoiling.
5. Scientific processes involved in the experimental phase require a scaling-up for the marketing phase.

SKILLS:

1. Use appropriate strategies in problem solving.
2. Apply data collection, organization, and interpretation skills.
3. Analyze data.
4. Analyze critically the possible impact on society of scientific research and technological development in the food industry.
5. Discuss biotechnology in the food industry from several perspectives (e.g., legal, ethical, economic, social).
6. Use controlled experimentation.

ATTITUDES:

1. Appreciate the ethical dilemmas that may arise from scientific and technological developments.
2. Appreciate the variety of factors that relate to the success of a given technological process.
3. Appreciate the interrelationships among science, technology, and society.
4. Appreciate the limits of science and technology in solving social problems.

TOPIC IV: BIOCHEMICAL APPLICATIONS (cont'd)

SUGGESTED SUBJECT MATTER:

1. Introductory Microbiology
2. Introductory Biochemistry
3. Food Production
4. Food Storage and Preservation
5. Biochemistry in Industry

SCOPE AND SEQUENCE
Electives

TOPIC: STELLAR EVOLUTION (Relates to Space Science) 5 hours

OVERVIEW

Students will study current theories of stellar evolution, seeing how a model is developed.

ACTIVITY

Review nuclear reactions. Focus on reactions which take place in stars.
Follow path for sun-sized star.
Follow path for 3x sun and for 10x sun, leading to black holes and neutron stars.
Relate to evidence of radio and X-ray astronomy.

SCOPE AND SEQUENCE
Electives

TOPIC: EXOBIOLOGY (Relates to Space Science) **5 hours**

OVERVIEW

Students will explore the factors in the possibility of there being other life forms, and of how we may search for them.

ACTIVITY

Are there other life forms? Explore the Drake equation as a model. Design a model that uses the Drake equation for determining the probability of something else, such as the number of perfect restaurants (described in Ch. 18 of The Search for Life in The Universe, by Donald Goldsmith). Look at factors of "What would life look like". Evaluate the various methods for looking; i.e., radio searches, Voyager record.

Debate the possibility of UFO's. Watch Cosmos XI, XII.

Debate the value of spending money on searches for extra-terrestrial intelligence.

SCOPE AND SEQUENCE

TOPIC I: Non-Renewable Energy Resources

25 hours

OVERVIEW

The focus of this unit is on science, technology and society.

Beginning with a review of the concept of energy systems and sources, and of the renewable sources discussed in General Science 20, the students will explore the implications of using non-renewable energy sources.

Students discuss several current non-renewable sources and evaluate the impact on society and the environment of each.

The technology associated with the extraction and distribution of non-renewable resources will be explored.

SUGGESTED SUBJECT MATTER

1. Review of the relevant concepts of General Science 10 and 20 units.
2. Classification of non-renewable resources.
3. Formation and Availability of Fossil Fuels (including equation of combustion).
4. Nuclear Equation and Technology (CANDU)(fission & fusion).
5. Technologies of resource extraction and distribution.
6. Patterns and trends in data.
7. Waste management. High temperature incinerator.

TOPIC II: Distance Communications

25 hours

OVERVIEW

The focus of the unit will be on science and technology associated with communications and space technologies.

A historical look at the telephone and the scientific principles behind it, lead the student into the concepts of electrostatics and electricity. Combining these principles with those of the electromagnetic spectrum provides a basis for modern communication and optical technologies.

Examination of the current technology being used for satellites, laser optics, and computers the students will speculate on future applications of emerging technologies.

SUGGESTED SUBJECT MATTER

1. Technology of the Telephone
2. Historical Development of the Telephone.
3. Optical Telescopes.
4. Radio Telescopes.
5. Electromagnetic Spectrum.
6. Orbital Dynamics. satellites (communications, survey, exploration, military).
7. Fiber Optics, Lasers.
8. Modems and Computers.
9. Liquid Crystals.
10. Robotics.

TOPIC III: Genetics

25 hours

OVERVIEW

The focus of the unit is on genetics with an emphasis on the nature of science.

It is to provide a continuation of biological processes from General Science 10 and 20.

By examining issues related to genetics students are to gain an understanding of the science. Students will consider the problems associated with the applications of genetics to the production of specialized organisms for use in industry.

SUGGESTED SUBJECT MATTER

1. Review of Relevant Biology from General Science 10 and 20.
2. Mendel's Laws of Inheritance.
3. Selective Breeding.
4. Mutation and cell repair.
4. DNA Replication.
5. Recombinant DNA Research and applications.

SCOPE AND SEQUENCE

TOPIC IV: Canadian Chemical Industries

25 hours

OVERVIEW

The focus of this unit is on Canadian chemical industries with an emphasis on the nature of science and technology.

The periodic table will be used to structure the study of the industrial preparation of metals, petrochemicals, fertilizers, and other commercial products. The study of chemical industries will be used to illustrate the nature of science and technology and the interrelationship between them. Examples of careers in chemistry will be included in the study.

SUGGESTED SUBJECT MATTER

1. Periodic Table.
2. Electrode Potential Table.
3. Metallurgy.
4. Fractional and Distillation.
5. Hydrocarbons.
6. Solvay Soda Process.
7. Fertilizer Production.

TOPIC I: NON-RENEWABLE ENERGY SOURCES

OVERVIEW:

The focus of this unit is on science, technology and society.

Beginning with a review of the concept of energy systems and sources, and of the renewable sources discussed in General Science 20, the students will explore the implications of using non-renewable energy sources.

Students discuss several current non-renewable sources and evaluate the impact on society and the environment of each.

The technology associated with the extraction and distribution of non-renewable resources will be explored.

OBJECTIVES:

CONCEPTS:

1. Some energy sources can be classified as non-renewable sources.
2. Various technologies are involved in the extraction and production of non-renewable energy resources.
3. Availability of non-renewable energy resources varies globally.
4. Patterns of energy use are factors in determining global responsibilities.
5. Energy use involves economic and political factors.
6. Our dependancies on energy need to be considered when planning for the future.

SKILLS:

1. Demonstrate ways to make efficient use of resources.
2. Examine social and political systems which influence energy resource policy.
4. Understand and apply data collection, organization, and interpretation skills.
5. Develop predictions based on available data.
6. Predict the possible impact of scientific research and technology development on society.
7. Recognize the components and interactions within systems.

ATTITUDES:

1. Appreciate the relationships among science, technology and society.
2. Possess an attitude of being in harmony with the environment.
3. To be concerned with the wise use of energy resources.
4. Appreciate the need to balance long term environmental and energy objectives with economic and social needs.

TOPIC I: NON-RENEWABLE ENERGY SOURCES (cont'd)

SUGGESTED SUBJECT MATTER:

1. Review of the relevant concepts of General Science 10 and 20 units.
2. Classification of non-renewable resources.
3. Formation and Availability of Fossil Fuels (including equation of combustion).
4. Nuclear Equation and Technology (CANDU)(fission & fusion).
5. Technologies of resource extraction and distribution.
6. Patterns and trends in data.
7. Waste management. High temperature incinerator.

TOPIC II: DISTANCE COMMUNICATIONS

OVERVIEW:

The focus of the unit will be on science and technology associated with communications and space technologies.

A historical look at the telephone and the scientific principles behind it, lead the student into the concepts of electrostatics and electricity. Combining these principles with those of the electromagnetic spectrum provides a basis for modern communication and optical technologies.

Examination of the current technology being used for satellites, laser optics, and computers the students will speculate on future applications of emerging technologies.

OBJECTIVES:

CONCEPTS:

1. Communication includes having messages sent, received and understood.
2. The technological developments of communications can be traced historically.
3. Technology has increased the opportunities for communication.
4. Communications technology involves scientific principles such as electrostatics, electronics, and the electromagnetic spectrum.
5. Physical optics has led to many technological devices for extending our senses.
6. The combining of optic and communication technologies has advanced our understanding of the earth and the universe.
7. Future technologies can assist us in space exploration.

SKILLS:

1. Develop and refine skills in observation.
2. Apply the principles of scientific method in exploring a device.
3. Use precise symbols and terminology of science in both written and oral communication.
4. Recognize components and interactions within systems.
5. To develop lateral thinking in considering alternatives uses or future uses of technology.
6. To develop skills involved in manipulating an electronic device.
7. Analyze critically the possible impact of scientific research and technological development on society.

ATTITUDES:

1. Appreciate that in solving problems scientifically new technologies develop.
2. Value the contributions of science and mathematics to our cultural heritage and to the progress of civilization.
3. Appreciate the relationship between science and technology.
4. Have an awareness of the importance of technology in our daily lives.
5. To appreciate that technology can be understood by the average person.
6. Appreciate ethical dilemmas that may arise from the application of scientific research and or technological developments.
7. That technologies developed for on purpose can often be applied to many different areas.

TOPIC II: DISTANCE COMMUNICATIONS (cont'd)

SUGGESTED SUBJECT MATTER:

1. Technology of the Telephone.
2. Historical Development of the Telephone.
3. Optical Telescopes.
4. Radio Telescopes.
5. Electromagnetic Spectrum.
6. Orbital Dynamics: satellites (communications, survey, exploration, military).
7. Fiber Optics, Lasers.
8. Modems and Computers.
9. Liquid Crystals.
10. Robotics.

TOPIC III: GENETICS

OVERVIEW:

The focus of the unit is on genetics with an emphasis on the nature of science.

It is to provide a continuation of biological processes from General Science 10 and 20.

By examining issues related to genetics students are to gain an understanding of the science. Students will consider the problems associated with the applications of genetics to the production of specialized organisms for use in industry.

OBJECTIVES:

CONCEPTS:

1. Genetic engineering involves fundamental principles from biological science.
2. Genetics is a discipline that exhibits phenomena which can be described in terms of mathematical relationships.
3. Genetic engineering can create new forms of life.
4. Medical technology cures disease, provides replacement parts for the body, and improves medical diagnoses.
5. Applications of genetic engineering and biotechnology involve social and ethical dilemmas.

SKILLS:

1. Apply data collection, organization,and interpretation skills.
2. Develop and refine skills of observation.
3. Analyze critically the possible impact on society of scientific research and technological development in genetic engineering.
4. Differentiate and analyze factors that are involved in successful technological processes.

ATTITUDES:

1. Appreciate the ethical dilemmas that may arise from the application of scientific and technological developments.
2. Appreciate that new technologies are often developed in response to a problem.
3. Appreciate the variety of factors that relate to a given technological process.
4. Appreciate the interrelationships among science, technology, and society.
5. Appreciate the limits of science in solving social problems.

TOPIC III: GENETICS (cont'd)

SUGGESTED SUBJECT MATTER:

1. Review of Relevant Biology from General Science 10 and 20.
2. Mendel's Laws of Inheritance.
3. Selective Breeding.
4. Mutation and cell repair.
4. DNA Replication.
5. Recombinant DNA Research and applications.

TOPIC IV: CANADIAN CHEMICAL INDUSTRIES

OVERVIEW:

The focus of this unit is on Canadian chemical industries with an emphasis on the nature of science and technology.

The periodic table will be used to structure the study of the industrial preparation of metals, petrochemicals, fertilizers, and other commercial products. The study of chemical industries will be used to illustrate the nature of science and technology and the interrelationship between them. Examples of careers in chemistry will be included in the study.

OBJECTIVES:

CONCEPTS:

1. The periodic table is a convenient means of organizing the elements on the basis of their chemical properties.
2. The method of extracting metals from their ores is related to their electrode potential.
3. Organic chemistry is the study of the molecular compounds of carbon.
4. Nitrogen, phosphorus, and sulfur are used to produce inorganic fertilizers.
5. Chemical industries require an abundant source of raw materials and energy.
6. Scientific and mathematical principles are the foundation of the development of technology and industry.

SKILLS:

1. Use precise symbols and terminology of science and mathematics in oral and written communication.
2. Utilize established scientific or mathematical models as a comparative base for observed data.
3. Analyze critically the possible impact of scientific research and technological development on society.
4. Recognize the components and interactions within a system.
5. Identify the steps involved in career preparation in order to facilitate career changes throughout life.

ATTITUDES:

1. Appreciate the usefulness of computational competence and problem solving skills.
2. Appreciate the relationship among science, technology, and society.
3. Appreciate the value of all types of work and of workers who contribute to a productive society.

TOPIC IV: CANADIAN CHEMICAL INDUSTRIES (cont'd)

SUGGESTED SUBJECT MATTER:

1. Periodic Table.
2. Electrode Potential Table.
3. Metallurgy.
4. Fractional and Distillation.
5. Hydrocarbons.
6. Solvay Soda Process.
7. Fertilizer Production.

SCOPE AND SEQUENCE
Electives

TOPIC: GASOLINE ADDITIVES (Relates to Non-Renewable Resources) 5 hours

OVERVIEW

Students will explore the claims made by oil companies relating to their additives.

ACTIVITY

If possible, students will perform labs on gasolines of various makers. Labs will focus on their cleaning abilities, and their combustion abilities. I appreciate that such a material may not be allowed to be worked with in a lab.

Alternatively, data from oil companies, can be analyzed to see if there are differences. Oil companies could be called upon to provide guest speakers to explain the chemistry of the additive.

TOPIC: FIELD TRIP OF OIL AND GAS FACILITY (Relates to Non-Renewable Resources) 5 hours

OVERVIEW

Students will spend a day visiting a facility to learn of the practical problems, and the technology of the industry.

ACTIVITY

Field trip to: refinery, gas plant, oil rig, seismic crew.
Time to be spent before and after on the scientific principles involved in the particular facility.

TOPIC: OIL SANDS TECHNOLOGY (Relates to Non-Renewable Resources) 5 hours

OVERVIEW

Students will explore the science and technology of the oil sands.

ACTIVITY

Obtain samples of oil sands. Design a method for extracting the oil. Test the design.
Study the technology involved with the oil sands operations that exist.

SCOPE AND SEQUENCE

Electives

TOPIC: NEW TECHNOLOGIES AROUND THE HOME (Relates to Communication and Emergency Technology)

5 hours

OVERVIEW

Students will be required to identify and explore a form of technology around the home.

ACTIVITY

This will be a research project on a new technology found in the home. Such new technologies could include VCR, alarm system, CD players, micro-wave oven. Research should include history of development, scientific principles, application to technologies. Students should also be required to derive alternative uses of the technology.

TOPIC: CANADIAN SPACE TECHNOLOGY (Relates to Space Technology)

5 hours

OVERVIEW

Students will research various aspects of the Canadian contribution to the technology of space and identify spin-offs of the technology.

ACTIVITY

Explore the specific contribution to communication technology of satellites such as Anik.
Explore the technology of the Canadarm.
Debate the merits of government funding of such technology.
Identify spin-offs of space technology.
Follow development of the identified items.
Explore costs of development.

TOPIC: INDUSTRIAL USES OF SPACE (Relates to Space Technology)

5 hours

OVERVIEW

Students will explore the feasibility of manufacturing in space.

ACTIVITY

Identify experiments which have been done in missions up to date, which relate to manufacture of items such as bearings, drugs.
Compare the advantages and disadvantages of manufacturing in space.
Discuss the technological problems of manufacturing in space.

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